

Permit Details

Permit No: PA0013714

Owner Name: Exelon Generation Company, LLC

Facility Name: Eddystone Generating Station

Facility Category: electric generating station

Stream Name: Delaware Estuary

Watershed(s):

Date application received: 4/3/2019

Permit expiration Date: 9/30/2019

Date sent to Services, PAFBC: 6/21/2019

Date sent to Services + 60 days: 8/20/2019

Part 1					
A. Source Waterbody Physical Description					
(r) Reports	Factor		Description	Notes	
§ 122.21 (r)(2)	1	Type of waterbody			
		Lotic/lentic	Lotic		
		Stream Width	6,201 feet		
		Stream flow volume (cfs)	9,448	monthly average at trenton for 2017	
		Pool elevation			
		Depth	Varies	maintained shipping channel is about 45 ft	
		Habitat Substrate	muddy bottom		
		Tidal (y/n)	Yes		
		Area of influence			
		2 Stream flow regime (at time of sampling)	Low/average/high; appeared to impact study/no noticeable impact to study	Monthly streamflow compared to historical streamflow for the sampling month	
		3 Historical stream flow			
			Critical period for entrainment	March through July	specified in application, weekly sampling during this time for their entrainment study
			Peak Stream Flow - mean monthly discharge	tidal	
			Q7-10 stream flow (if known)	tidal	
		4 Managed (regulated) flow (y/n)	Y/N	Yes	managed releases from reservoirs to ensure salt line stays below drinking water intakes
			If yes, explain how		
			If yes, explain time periods	during drought periods	
		5 Water Temperatures	Daily mean water temperatures during critical period	40 (march) - 80 (july)	
	6 316(a) Variance issued to the permittee? (appropriate to consider under § 122.21 (r) based on 125.98(f)(3)(ii))	(Y/N); note relative information	No	permit specifies not to exceed 5F above zone 4 DRBC average temperature table shown in permit outside of the mixing zone which is 210ft up and downstream and 400ft laterally away from outfall	
	7 Protected use	(e.g. CWF, WWF, HQ, EV)	WWF (maintenance only), MF (passage only)		
B. Facility Description					
(r) Reports	Factor		Description	Notes	
§ 122.21 (r)(3) and (r)(5)	1	Intake structure location(s)			
		shoreline	Shoreline		
		Off-shore/thalweg			
		Located in/near sensitive habitat or species (nursery areas, spawning habitat, etc.)?		Designated critical habitat for atlantic sturgeon	
		Percentage of withdrawn water used for cooling	99.9%		
§§ 122.21 (r)(3) and (r)(5)	2	Existing technology(ies) at the facility	Examples: Closed cycle cooling (CCC) Submerged wedge wire screens Traveling screens with fine mesh screens and a fish return system Traveling screens with fine mesh screens, without a fish return system Standard traveling screens with a fish return system Standard traveling screens without a fish return system Variable frequency drive (VFD) for the circulating water pumps Barrier devices Design through-screen velocity of < 0.5 fps Stationary water screens	Once through cooling, standard traveling screens withough a fish return system	Unite 3 and 4 CWISs designed with deeper intake forebays to reduce approach velocity to 0.43 fps, lateral fish escapes in the forebay infront of the traveling screens, curtain wall reduce vulnerability of organims in the upper portion of the water column.
		If other, please describe:			
	3	Existing operational measures to reduce IM&E	Select from Drop-down Menu		retirement of Units 1 and 2, curtail pump usage when not generating power reduces impingment and entrainment losses 71% and 67% respectively compared to DIF
		If other, please describe:			
	4	Proportion of source waterbody withdrawn	% of flow of waterbody withdrawn by facility (at time of sampling/critical period; note: 1 cfs = 373.7301 gpm)	average 0.24%, to a max of 0.73% in August of 2015	based on Delaware Estuary volumn estimated in a 1999 PSE&G report
	5	Cooling Water Intake Structures (CWISs) (complete this section 1ce for each intake structure)	CWIS number X of Y total CWISs (e.g. 1/3, 2/3, etc.)	4 identical intake bays for the two units	
			Operation by an Independent Supplier (Y/N)	No	
			DIF (cfs)	835.2 MGD	
			AIF (cfs, average over last 3 years) ((r)(5))	262.6 MGD	2013-2017
		AIF at critical period	249.5 MGD	based on averages provided in Table III-1 March through July	

			Intake structure's area of influence within the stream	approximately 70 feet into the river with a width equal to the width of the intake	based on modeling done by consultant, results indicated velocity into the CWIS is much lower than velocities in the river adjacent to the intake
			Location of CWIS in the watrbody (e.g. shoreline, offffshore)	Shoreline	forebay extending 13 feet into the river
			Daily hours of operating	CWIS avgs 17 hrs/day over 5 years	
			No of days/week operating	7	
			No. of days/year operating	some type of withdrawal every day for "station support", the larger circulating water pumps operated on average 271 days/year	
§§ 122.21 (r)(3) and (p)(5)			Seasonal changes in operation (if applicable)	max operations in summer during peak electricity demands	
	6	Additional Operational Measures	Protective measures and stabilization activities that have been implemented, or are required based on the NPDES permit	Unite 3 and 4 CWISs designed with deeper intake forebays to reduce approach velocity to 0.43 fps, lateral fish escapes in the forebay infront of the traveling screens, curtain wall reduce vulnerability of organisms in the upper portion of the water column.	
§ 122.21 (r)(6)	7	Selected /proposed impingement BTA alternative	Select from Drop-down Menu	Low capacity utilization rate with a withdrawal reduction SOP	
			Flow distribution and water balance diagram included (y/n) and if so, where is it located?	yes	permit application 316(b) report section III figures
			Engineering drawings of the cooling water structure(s) provided, and if so, are they legible?	yes	
	8	Recommendations from PAFBC, USFWS, Commissions (Services), etc.; <i>describe:</i>		only comment was from NOAA saying that they don't have a comment since the facility is applying for a section 10 IITP	
Submittal not required	9	Cumulative impacts (from multiple sources, e.g. multiple intake structures from same facility, or from other, nearby facilities); <i>describe:</i>			
C. Source Waterbody Baseline Study Biological Description					
(r) Reports	Factor		Description		Notes
§ 122.21 (r)(4)	1	Location of Baseline Study	Onsite at the facility's CWIS		Facility's own studies used for the biological description. Other studies referenced but results not included.
	2	Date of Baseline Study	2005-2006 and 2016-2017		
	3	Baseline study; types of organisms - fish, mussels, other sensitive species - present in the waterbody (it is strongly recommended to use the "Species Baseline Data" worksheet to describe all factors in this section).		see species baseline study tab	
§ 122.21 (r)(4)	4	Primary period of reproduction, larval recruitment, and period of peak abundance for relevent taxa ( <i>it is recommended to use the "Species Baseline Data" worksheet to describe all factors in this section</i> )			
	5	Critical species			
		Commercially and recreationally important species	A list of PA Fish Species by Watershed and their status can be located here: <a href="https://www.fishandboat.com/Fish/PennsylvaniaFishes/">https://www.fishandboat.com/Fish/PennsylvaniaFishes/</a> - PA fishes by watershed		
		T&E species  Note: USFWS T&E Fish Species also included as a worksheet in this Excel file.	See above link to PA Fish Species by Watershed, and, A list of all Federally listed threatened and endangered species can be located here: <a href="https://ecos.fws.gov/">https://ecos.fws.gov/</a> - T&E listed species		
		Migratory species, spawning times	Migratory fish		
		Fish species that are known hosts to mussel glochidia	One resource to PA freshwater mussels and their glochidia host fish species can be located in a different worksheet within this Excel file (see the bottom tabs) as well as online, here: <a href="https://pa.fisheries.org/wp-content/uploads/2018/02/Mussel-ID-workshop-field-guide-2-9-18.pdf">https://pa.fisheries.org/wp-content/uploads/2018/02/Mussel-ID-workshop-field-guide-2-9-18.pdf</a>		



§ 122.21 (r)(4)	Nuisance species (includes, but not limited to: Bighead, Silver and Black carp; Round goby; Snakehead; European rudd; Ruffe, Tubenose goby, Rusty crayfish)	A list of Aquatic Invasive Species within PA can be located here: <a href="https://www.fishandboat.com/Resource/AquaticInvasiveSpecies/Pages/default.aspx">https://www.fishandboat.com/Resource/AquaticInvasiveSpecies/Pages/default.aspx</a>		
	Fragile species (as defined at 125.92(m))	Includes, but not limited to: alewife, American shad, Atlantic herring, Atlantic long-finned squid, Atlantic menhaden, bay anchovy, blueback herring, bluefish, butterfish, gizzard shad, grey snapper, hickory shad, menhaden, rainbow smelt, round herring, and silver anchovy	Alewife, American shad, Atlantic menhaden, bay anchovy, blueback herring, and gizzard shad were commonly found in their studies	
	Balanced Indigenous Population present during baseline study?	(Based on report and DEP Aquatic Biologist's BPI)	Yes	
D. Entrainment Performance study(ies) - Historical Studies § 122.21 (r)(7)				
(r) Reports	Factor		Description	Notes
Historical Studies § 122.21 (r)(7)	1 Latent mortality study (if done onsite at the facility with their current technology); (does it demonstrate mortality <100%? Grade on bpj on a scale of 1-10)		no studies provided	
	2 Location of Entrainment study	Onsite at the facility's CWIS		
	If not at the facility, describe location:			
	If not at the facility, is study relevant to this facility?			
	3 Date of the Entrainment Study		2005-2006	impingement and entrainment
	If > 10 years, is study relevant to this facility?			
Historical Studies § 122.21 (r)(7)	4 Types and numbers of entrained organisms; (it is strongly recommended to use the "Species Entrainment Data" worksheet to describe all factors in this section),			
	Commercially and recreationally important species	A list of PA Fish Species by Watershed and their status can be located here: <a href="https://www.fishandboat.com/Fish/PennsylvaniaFishes/GalleryPennsylvaniaFishes/Documents/GalleryofPaFishes-Chapter2-SpeciesbyWatersheds.pdf">https://www.fishandboat.com/Fish/PennsylvaniaFishes/GalleryPennsylvaniaFishes/Documents/GalleryofPaFishes-Chapter2-SpeciesbyWatersheds.pdf</a>		
	T&E species	See above link to PA Fish Species by Watershed, and, A list of all Federally listed threatened and endangered species can be located here: <a href="https://ecos.fws.gov/ecp0/reports/ad-hoc-species">https://ecos.fws.gov/ecp0/reports/ad-hoc-species</a>		
	Migratory species, spawning times			
Historical Studies § 122.21 (r)(7)	Fish species that are known hosts to mussel glochidia	One resource to PA freshwater mussels and their glochidia host fish species can be located here: <a href="https://pa.fisheries.org/wp-content/uploads/2018/02/Mussel-ID-workshop-field-guide-2-9-18.pdf">https://pa.fisheries.org/wp-content/uploads/2018/02/Mussel-ID-workshop-field-guide-2-9-18.pdf</a>		
	Nuisance species (includes, but not limited to: Bighead, Silver and Black carp; Round goby; Snakehead; European rudd; Ruffe, Tubenose goby, Rusty crayfish)	A list of Aquatic Invasive Species within PA can be located here: <a href="https://www.fishandboat.com/Resource/AquaticInvasiveSpecies/Pages/default.aspx">https://www.fishandboat.com/Resource/AquaticInvasiveSpecies/Pages/default.aspx</a>		
	Fragile species			
		Calculate total number (and density) of the above important species:		
	Eggs entrained during study period (total number)	Total number of eggs		
	Eggs entrained annually (typically calculated by permittee)			
	Gallons of water collected during study period	=(# of samples collected * gallons/sample)		
§ 122.21 (r)(7)	Calculate density of eggs entrained (# of eggs entrained per gallon of surface water withdrawn):			
	Larvae entrained during study period (total number)			

Historical Studies	Larvae entrained annually (typically calculated by permittee)			
	Calculate density of larvae entrained (# of eggs entrained per gallon of surface water withdrawn):			
E. Entrainment Characterization Study - Recent/current study § 122.21 (r)(9)				
(r) Reports	Factor		Description	Notes
Recent / Current Studies § 122.21 (r)(9), or from additional information requested by the Department § 122.21 (r)(1)(ii)(C)	1 Location of the Entrainment Study	Onsite at the facility's CWIS		
	If not at the facility, describe location:			
	If not at the facility, is study relevant to this facility?			
	2 Date of the Entrainment Study		2016-2017	
	If > 10 years, is study relevant to this facility?			
	3 Types and Numbers of entrained organisms; (it is strongly recommended to use the "Species Entrainment Data" worksheet to describe all factors in this section),		See Species Entrainment Data for 2016 and 2017 tabs	
	Commercially and recreationally important species	A list of PA Fish Species by Watershed and their status can be located here: <a href="https://www.fishandboat.com/Fish/PennsylvaniaFishes/GalleryPennsylvaniaFishes/Documents/GalleryofPaFishes-Chapter2-SpeciesbyWatersheds.pdf">https://www.fishandboat.com/Fish/PennsylvaniaFishes/GalleryPennsylvaniaFishes/Documents/GalleryofPaFishes-Chapter2-SpeciesbyWatersheds.pdf</a>	multiple	
Recent / Current Studies § 122.21 (r)(9), or § 122.21 (r)(1)(ii)(C)	T&E species	See above link to PA Fish Species by Watershed, and, A list of all Federally listed, threatened and endangered species can be located here: <a href="https://ecos.fws.gov/ecp0/reports/ad-hoc-species">https://ecos.fws.gov/ecp0/reports/ad-hoc-species</a>		
	Consider running a PNDI Search		Atlantic Sturgeon, Short nose sturgeon	
	Migratory species, spawning times		Herring, striped base, american eel, + others	
Recent / Current Studies § 122.21 (r)(9), or from additional information requested by the Department § 122.21 (r)(1)(ii)(C)	Fish species that are known hosts to mussel glochidia	One resource to PA freshwater mussels and their glochidia host fish species can be located here: <a href="https://pa.fisheries.org/wp-content/uploads/2018/02/Mussel-ID-workshop-field-guide-2-9-18.pdf">https://pa.fisheries.org/wp-content/uploads/2018/02/Mussel-ID-workshop-field-guide-2-9-18.pdf</a>	most	
	Nuisance species (includes, but not limited to: Bighead, Silver and Black carp; Round goby; Snakehead; European rudd; Ruffe, Tubenose goby, Rusty crayfish)	A list of Aquatic Invasive Species within PA can be located here: <a href="https://www.fishandboat.com/Resource/AquaticInvasiveSpecies/Pages/default.aspx">https://www.fishandboat.com/Resource/AquaticInvasiveSpecies/Pages/default.aspx</a>	none identified	
	Fragile species		alewife American shad, Atlantic menhaden, bay anchovy, blueback herring, and gizzard shad	
		Calculate total number (and density) of the above important species:		
	Eggs entrained during study period (total number)	Total number of eggs	1,727	
	Eggs entrained annually (typically calculated by permittee)			
	Gallons of water collected during study period	=(# of samples collected * gallons/sample)	6,700,000	256 samples targeting 100 cubic meters (26417 gallons) per event
Recent / Current Studies § 122.21 (r)(9), or § 122.21 (r)(1)(ii)(C)	Calculate density of eggs entrained (# of eggs entrained per gallon of surface water withdrawn):		0.00026	
	Larvae entrained during study period (total number)		11,600	
	Larvae entrained annually (typically calculated by permittee)			
	Calculate density of larvae entrained (# of eggs entrained per gallon of surface water withdrawn):		0.0017	
F. Land availability (related to feasibility of control technologies)				
(r) Reports	Factor		Description	Notes
§ 122.21 (r)(10)	1 Does the applicant have land to include necessary control technologies (on site or adjacent to site)?		Several options for plume abated mechanical draft cooling towers are presented, the most cost effective would include installing a unit on an adjacent property	

	2	Consider environmental impacts to using/acquiring the land			
G. Benefits Valuation Study					
(r) Reports	Factor		Description	Notes	
(r)(11) when applicable					
H. Social benefits and technology costs					
(r) Reports	Factor		Description	Notes	
	1	Quantified and qualitative social benefits and costs of control technology		See adjacent summary provided based on the provided R10-11 reports	
	2	Has the applicant adequately demonstrated costs/benefits?		report plans and reports were submitted to DEP approved peer reviewers.	
	3	Is it a robust comparison of cost/benefits?		facility argues yes. Appears robust	
I. Impact of changes in particulate emissions or other pollutants					
(r) Reports	Factor		Description	Notes	
§ 122.21 (r)(12)		Will the control measures require amendment to increase loads or cause exceedances to existing limits?		doesn't appear to impact NPDES permit limits, maybe air quality	
J. Remaining useful plant (the facility) life					
(r) Reports	Factor		Description	Notes	
		Is the facility terminating operations/closing within the next 10 years?		projected installation of control technologies listed as possible between now to 2024 based on option resulting in 9 - 14 years of operation remaining	
			anticipated retirement data of 2033		
K. Additional factors that <i>may</i> be considered for BTA Determinations (if information was submitted by permittee)					
(r) Reports	Factor		Description	Notes	
Submittal not required	1	Entrainment impacts on waterbody		AKRF determined that based on analysis of spawning potential ratio associated with Eddystone entrainment at DIF, the facility is likely too small to jeopardize the sustainability of the most commonly entrained fish populations.	represents worst case scenerio based on DIF and assumed 0% entrainment survival rate
	2	Thermal discharge impacts, thermal plumes (e.g. 316(a) variance in place)		report says CCC, VSP, and flow reduction alternatives would result in less heat discharged and small plume size, but plum associated with current discharge is small and protective according to DRBC	
	3	Credit for reductions in flow associated with retirement of units within 10 years preceding 10/14/2014		Units 1 and 2 retired 2011 and 2012 respectively which used approximately 634 MGD	results in 43.2% reduction in DIF
	4	Impacts on reliability of energy delivery within the immediate area		described in the part 2 worksheet for various alternatives	
	5	Impacts on water consumption		described in the part 2 worksheet for various alternatives	
	6	Availability of process water, gray water, waste water, reclaimed water for reuse as cooling water		Considered not feasible by the facility	
L. Other environmental negative impacts (optional)					
(r) Reports	Factor		Description	Notes	
Submittal not required	1	Use of biocides by the facility, e.g. use at critical period		used when ambient intake temp is at or above 50F (typically April through November) during 3-40 minute periods at 8 hr intervals	application talks about entrainment survival. Facility assumed 0% entrainment survival during treatment events.
	2	Other known environmental impacts			

Table X-4 Comparison of net present value of social costs and monetized benefits for Alternatives at Eddystone				
Discount Rate	Alternative	Social Costs	Monetized Benefits	
			Lit-Reported Survival	0 Survival
3%	FM MTS	\$13,100,000	\$2,111,776	\$3,511,776
	VSP	\$42,300,000	\$1,024,855	\$1,474,855
	CWWS	\$17,300,000	\$3,027,084	\$4,327,084
	Flow Reduction	-\$6,300,000	\$3,598,103	\$5,398,103
	CCRS	\$264,000,000	\$2,667,255	\$3,867,255
7%	FM MTS	\$10,900,000	\$1,440,689	\$2,340,689
	VSP	\$33,200,000	\$716,740	\$1,016,740
	CWWS	\$14,800,000	\$2,000,774	\$2,900,774
	Flow Reduction	-\$4,400,000	\$2,620,761	\$3,920,761
	CCRS	\$213,200,000	\$1,743,339	\$2,493,339

**Existing Technologies:**

Select from Drop-down Menu
Closed cycle cooling (CCC)
Submerged wedge wire screens
Traveling screens with fine mesh screens and a fish return system
Traveling screens with fine mesh screens, without a fish return system
Standard traveling screens with a fish return system
Standard traveling screens without a fish return system
Variable frequency drive (VFD) for the circulating water pumps
Barrier devices
Design through-screen velocity of < 0.5 fps
Stationary water screens
Other

**Existing Operational Measures:**

Select from Drop-down Menu
Seasonal reductions in operations/flow
Scheduled outages during critical periods
Discontinuance of biocides during critical periods
Other

**Proposed / Selected Impingement Mortality Standard Alternative**

Select from Drop-down Menu
Closed cycle cooling
Through-Screen Design Velocity < 0.5 fps
Through-Screen Actual Velocity < 0.5 fps
Existing Offshore velocity cap
Modified traveling screens as defined at 125.92(s)
Systems of technologies
Impingement mortality performance standard

**Entrainment Study Location**

Select from Drop-down Menu
Onsite at the facility's CWIS
Offsite

**Entrainment Study (cont.)**



Yes
No

**Entrainment Study (cont.)**

Select from Drop-down Menu
Within the previous 10 years
> the previous 10 years

Part 2 - Technology Comparison for Entrainment

		Closed Cycle Cooling	Cylindrical Wedge Wire Screens Coarse Mesh	Seasonal Operational Measures	Variable Speed Pumps	Fine Mesh Modified Traveling Screen	Low Capacity Utilization and revised pump usage SOP (their proposed IM BTA)	Alternative Water Sources
1)	Was this technology evaluated in the 316 (b) reports? (y/n)	Yes	Yes	No	Yes	Yes	Yes	No
2)	Did the facility indicate whether this technology is available/feasible for the facility? (y/n)	Only type determined feasible are plume abated mechanical draft cooling towers, other types deemed infeasible due to plume impacts to boeing test facility and philly airport, or facility design	Fine mesh CWW deamed not feasible, coarse deamed feasible but challenging	peaking plant told when to operate by PJM	"feasible but would present challenges"	"challenging but feasible"	feasible	not feasible
3)	Why is, or why isn't the technology available to the facility?	described as feasible with several challenges including purchasing adjacent property for most cost effective layout, significant disturbances to existing layout of pipelines and infrastructure causing extended disruptions, permitting requirements for work done in waters of the US, higher pump and fan operations, etc..			actual flow reductions that could be achieved would require a detailed design evaluation	available as retrofit of existing TWSs		not enough groundwater or greywater for cooling needs
4)	Note any pros to this technology.		minimal noise (maybe with airburst); previously operated coarse CWW at Units 1 and 2 with no safety issues; no expected reliability issues; no new water consupction		decreased noise due to decreased pumping rates potentially; no additional safety concerns; no impact to reliability; no additional consumptive water use	Least expensive retrofit current TWS, no significant noise increase; no expected additional safety concerns, no additional consumptive water use	would save money; decreased energy consumption; decrease air pollution due to decrease energy consumption; no safety impacts, decreased noise; no reliability impactsno additional consumptive water use	
5)	Note any cons to this technology.	increased energy consumption due to installation outage, running fans, and less efficient; increased air pollution (PM) from the towers, increase emissions from extra energy needed to run the towers, one time increase in emissions due to outage required from a different plant; probably increased noise beyond property boundary during operation and construction; eventhough plum abated, still possible fogging and icing = safety concerns; reliability concerns during peak production July-August; evaporative water loss to the river requiring DRBC consumptive use replacement plan; most expensive option	slight increase in energy use for compressors for the air burst system; minor increase in air pollution due to increased energy use		minor increased energy use; minor increase air pollution due to increased energy use;	increased energy use due to constantly operating screens; minor increase in air emissions due to increased energy use; possible reliability issues more than current TWS		
6)	Note the anticipated improvements over existing technology, as it relates to entrainment of biological organisms.	If using literature reported survival rates = 98.2% decrease in entrainment losses; if using 0% survival = 98.6% decrease in losses	If using literature reported survival rates = 43.3% decrease in entrainment losses; if use 0% survival = 43.7% decrease in losses.		28.5% decrease in entrainment losses if either using literature reported survival rates or 0%	If using literature reported survival rates = 2.4% increase in entrainment losses due to increase impingment mortality, if use 0% entrainment survival = 8.6% decrease in	If using literature reported survival rates = 70.9% reduction in entrainment losses; if use 0% survival = 72.7%	

Common Name	Scientific Name	Critical Species *	Residency Status (Native/Introduced)	Primary Pd. of reproduction	Larval recruitment Pd.	Peak Abundance
alewife	<i>Alosa pseudoharengus</i>	Migratory	Native	April - early May		
American eel	<i>Anguilla rostrata</i>	Migratory, Com/Rec	Native	Late April - August		
American shad	<i>Alosa sapidissima</i>	Migratory, Com/Rec	Native	late May- mid June		
	<i>Micropogonias undulatus</i>	Com/Rec	Native			March - October a
Atlantic croaker				Fall to winter in ocean		Juveniles in Estuar
Atlantic menhaden	<i>Brevoortia tyrannus</i>	Com/Rec	Native	Winter spawning		
Atlantic silverside	<i>Menidia menidia</i>		Native			
	<i>Acipenser oxyrinchus oxyrinchus</i>	Federally Endangered	Native			
Atlantic sturgeon						
banded killifish	<i>Fundulus diaphanus</i>		Native	May - August		
bay anchovy	<i>Anchoa mitchilli</i>	Forage	Native	April - September		
black drum						
						August-November
blue crab	<i>Callinectes sapidus</i>	Com/Rec	Native	April - October		adults
blueback herring	<i>Alosa aestivalis</i>	Migratory	Native	April - mid August		
bluefish	<i>Pomatomus saltatrix</i>		Native			
bluegill sunfish	<i>Lepomis macrochirus</i>	Rec	Introduced	May - Aug		
			Introduced in Delaware			
bowfin	<i>Amia calva</i>		River	mid April - mid June		
brown bullhead	<i>Ameirurus nebulosus</i>	Rec	Native	May - June		
channel catfish	<i>Ictalurus punctatus</i>	Rec	Introduced	May - July		
common carp	<i>Cyprinus carpio</i>		Introduced	Spring - Summer		
eastern silvery minnow	<i>Hybognathus regius</i>		Native	late April - early May		
gizzard shad	<i>Dorosoma cepedianum</i>	Forage	Native	mid March - Summer		
	<i>Notemigonus cyrsoleucas</i>		Native	April - August		
golden shiner						
grass shrimp	<i>Palaemonetes pugio</i>					
		Migratory, PA				
hickory shad	<i>Alosa mediocris</i>	endagnered	Native	March - April		
hogchoker	<i>Trinectes maculatus</i>		Native	April - October		
largemouth bass	<i>Micropterus salmoides</i>	Rec	Introduced	May - June		
longnose gar						
mummichog	<i>Fundulus heteroclitus</i>		Native	spring - summer		
rough silverside	<i>Membras marinica</i>		Native			
						Spawn upstream o
						Trenton not expec
Shortnose Sturgeon	<i>Acipenser brevirostrum</i>	Endangered				there as entrainab
spot	<i>Leiostomus xanthurus</i>		Native			
striped bass	<i>Morone saxatilis</i>	Migratory, Rec	Native	April - June		
tessellated darter	<i>Etheostoma olmstedi</i>		Native	late March - early May		
weakfish	<i>Cynoscion regalis</i>					
white catfish	<i>Ameiurus catus</i>	Rec	Native	June - early July		
white crappie						
white perch	<i>Morone americana</i>	Rec	Native	April - June		
	<i>Catostomus commersonii</i>		Native			
white sucker			Native	April - early May		
yellow perch	<i>Perca flavescens</i>	Rec	Native	late Winter - Summer		

\* Critical species status would include: commercially and recreationally important species, T&E species, migratory species, etc.

Taxon	Percent Composition	Estimated Number Entrained during Sample period			Life History, No. of Eggs/female			RIS (Y/N)	Notes	Unknown Life Stage	Eggs

Numbers entrained and corresponding age-1 ex

Taxon	Numbers Entrained	
	Baseline Conditions	Existing Conditions
American eel	907,650	231,909
American shad	1,784,984	525,570
Atlantic croaker	29,557,250	6,442,866
Atlantic menhaden	3,130,913	696,864
Bay anchovy	3,343,724	1,851,623
Blue crab	685,260	308,507
Channel catfish	1,045,521	559,606
Gizzard shad	16,877,627	5,280,778
Herrings	172,167,175	54,939,810
Striped bass	52,755,992	17,737,189
White perch	46,697,279	14,435,950
Other species	10,775,577	3,342,658
<b>Total</b>	<b>345,809,051</b>	<b>108,565,661</b>



Yolk-sac larvae	Post yolk-sac		Young of Year	Yearling plus	Total
	larvae				

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**Table X-1**  
**equivalents under baseline (i.e., DIF) and**  
**existing (i.e., AIF) conditions at Eddystone**

	Age-1 Equivalents	
	Baseline Conditions	Existing Conditions
	123,227	37,820
	196	61
	478,794	119,364
	6,884	1,807
	135,215	76,003
	8,013	3,608
	45,061	12,310
	291	93
	16,636	5,410
	18,038	7,197
	234,114	102,521
	1,083,716	283,051
0	2,229,055	672,858

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Naked Goby	0	0	1	3	0	0	0	4
New World Silverside Family	0	0	1	0	0	0	0	1
Striped Bass	6	35	386	10	0	0	0	437
Striped Killifish	0	1	0	0	0	0	0	1
Summer Flounder	0	0	1	0	0	0	0	1
Tessellated Darter	0	33	3	0	0	1	0	37
Unidentified Osteichthyes	0	0	2	0	0	8	0	10
White Perch	677	3	570	15	0	1	0	1266
Yellow Perch	0	0	1	0	0	0	0	1
Total	1055	159	5673	107	1	49	15	7059



Table 5.2-2. Total number of each life stage of fish and shellfish collected in Eddystone Generating Station entrainment samples during 2017.

Taxon	Life Stage							Total
	Eggs	YSL	PYSL	YOY	YROL	Unid.	Post-larva	
American Eel	0	0	0	14	1	0	0	15
American Shad	0	1	54	2	0	0	0	57
Atlantic Croaker	0	0	46	23	0	11	0	80
Atlantic Menhaden	0	0	30	4	0	0	0	34
Atlantic Sturgeon	0	1	0	0	0	0	0	1
Bay Anchovy	0	0	60	3	0	0	0	63
Carp and Minnow Family	0	80	64	1	0	11	0	156
Channel Catfish	0	0	0	23	1	0	0	24
Common Carp	0	5	5	0	0	4	0	14
Crappie Species	0	0	1	0	0	0	0	1
Flathead Catfish	0	0	0	3	0	0	0	3
Gizzard Shad	390	104	0	0	0	0	0	494
Herring Family	0	0	150	0	0	0	0	150
Hogchoker	0	0	0	1	1	0	0	2
Lepomis Species	0	0	10	0	0	0	0	10
Morone Species	0	0	227	0	0	184	0	411
Mummichog	0	0	1	0	0	0	0	1
New World Silverside Family	0	0	3	0	0	0	0	3
Rough Silverside	0	0	1	0	0	0	0	1
Striped Bass	7	63	1195	0	0	0	0	1265
Tessellated Darter	0	26	11	0	0	0	0	37
White Perch	250	8	381	10	0	0	0	649
Yellow Perch	0	1	0	0	0	0	0	1
Blueback Herring/Alewife	3	0	0	1	0	0	0	4
Blueback Herring/Hickory Shad/Alewife/Gizzard Shad	2	0	2754	0	0	0	0	2756
Blueback Herring/Hickory								

own  
age Eggs



Yolk-sac larvae	Post yolk-sac larvae	Young of Year	Yearling plus	Total

<i>Shad/Alewife</i>	12	1	0	0	0	0	0	13
Blue Crab	0	0	0	0	0	0	8	8
Grass Shrimp	0	0	0	0	0	0	2	2
Unidentified Osteichthyes	8	0	2	0	0	3	0	13
Total	672	290	4995	85	3	213	10	6268
Percent Composition	10.7	4.6	79.7	1.4	0.0	3.4	0.2	100.0



Total number of fish and shellfish impinged and frequency of occurrence in each 12-hour impingement sample at Eddystone Generating Station, April 20, 2005 - March 28, 2006.

Family Name		Species Name		Total Number	Frequency of Occurrence <sup>1</sup>
Scientific	Common	Scientific	Common		
Clupeidae	herrings	<i>Alosa pseudoharengus</i>	alewife	778	45
Anguillidae	freshwater eels	<i>Anguilla rostrata</i>	American eel	1	1
Clupeidae		<i>Alosa sapidissima</i>	American shad	95	18
Sciaenidae	drums	<i>Micropogonias undulatus</i>	Atlantic croaker	703	25
Clupeidae		<i>Brevoortia tyrannus</i>	Atlantic menhaden	36	11
Cyprinodontidae	killifishes	<i>Fundulus diaphanus</i>	banded killifish	8	8
Engraulidae	anchovies	<i>Anchoa mitchilli</i>	bay anchovy	835	21
Sciaenidae		<i>Pogonias cromis</i>	black drum	1	1
Portunidae	swimming crabs	<i>Callinectes sapidus</i>	blue crab	2,389	27
Clupeidae		<i>Alosa aestivalis</i>	blueback herring	132	32
Pomatomidae	bluefishes	<i>Pomatomus saltatrix</i>	bluefish	2	2
Centrarchidae	sunfishes	<i>Lepomis macrochirus</i>	bluegill	25	14
Amiidae	bowfins	<i>Amia calva</i>	bowfin	1	1
Ictaluridae	bullhead catfishes	<i>Ameiurus nebulosus</i>	brown bullhead	6	5
Ictaluridae		<i>Ictalurus punctatus</i>	channel catfish	160	47
Cyprinidae	carps and minnows	<i>Cyprinus carpio</i>	common carp	1	1
Cyprinidae		<i>Hybognathus regius</i>	eastern silvery minnow	29	13
Clupeidae		<i>Dorosoma cepedianum</i>	gizzard shad	170	24
Cyprinidae		<i>Notemigonus crysoleucas</i>	golden shiner	1	1
Soleidae	soles	<i>Trinectes maculatus</i>	hogchoker	278	32
Lepisosteidae	gars	<i>Lepisosteus osseus</i>	longnose gar	1	1
Cyprinodontidae		<i>Fundulus heteroclitus</i>	mummichog	1	1
Gobiidae	gobies	<i>Gobiosoma bosc</i>	naked goby	11	7
Sciaenidae		<i>Leiostomus xanthurus</i>	spot	58	21
Cyprinidae		<i>Notropis hudsonius</i>	spottail shiner	4	4
Moronidae	temperate basses	<i>Morone saxatilis</i>	striped bass	41	19
Percidae	perches	<i>Etheostoma olmstedii</i>	tessellated darter	4	4
Sciaenidae		<i>Cynoscion regalis</i>	weakfish	131	13
Centrarchidae		<i>Pomoxis annularis</i>	white crappie	7	6
Moronidae		<i>Morone americana</i>	white perch	3,001	70
Percidae		<i>Perca flavescens</i>	yellow perch	1	1



Post yolk-sac larvae	Young of Year	Yearling plus	Total

perchae	<i>Perca flavescens</i>	yellow perch	4	4
Total	30		8,914	

<sup>1</sup> A total of 86 12-hour impingement samples were collected.



**PA Freshwater Mussel Species and their Host Fish**

Fed. Endangered	Fed. Endangered
Fed. Candidate	Fed. Candidate
State Endangered	State Endangered
State Candidate	State Candidate
State Endangered, Fed. Threatened	State Endangered, Fed. Threatened

Species:	Common Name:	Status:	Fish Host(s)(known or suspected):
Actinonaias ligamentina	mucket		American eel, central stoneroller, common carp, silverjaw minnow, tippecanoe darter, banded killifish, green sunfish, orangespotted sunfish, bluegill, smallmouth bass, largemouth bass, white bass, tadpole madtom, yellow perch, white crappie, black crappie, blacknose dace, sauger, creek chub
Alasmidonta heterdon	dwarf wedgemussel	Fed. Endangered	mottled sculpin, slimy sculpin, tessallated darter, banded killifish, striped bass, shield darter, Altantic salmon, brown trout
Alasmidonta marginata	elktoe		rock bass, white sucker, northern hog sucker, warmouth, shorthead redhorse
Alasmidonta undulata	triangle floater		white sucker, central stoneroller, slimy sculpin, spotfin shiner, fantail darter, common shiner, pumpkinseed, largemouth bass, northern hog sucker, rosyface shiner, blackside darter, blacknose dace, longnose dace, fallfish
Alasmidonta varicosa	brook floater	fed. candidate	slimy sculpin, pumpkinseed, golden shiner, margined madtom, yellow perch blacknose dace, longnose dace
Amblema plicata	threeridge		rock bass, white bass, northern hog sucker, warmouth, black redhorse, freshwater drum, spotfin shiner, steelcolor shiner, streamline chub, northern pike, mooneye, channel catfish, shortnose gar, green sunfish, pumpkinseed, bluegill, largemouth bass, golden redhorse, emerald shiner, yellow perch, logperch, white crappie, black crappie, flathead catfish, sauger
Anodontoides ferussacianus	cylindrical papershell		white sucker, mottled sculpin, brook stickleback, spotfin shiner, Iowa darter, Tippecanoe darter, bluegill, common shiner, largemouth bass, blacknose shiner, sea lamprey, bluntnose minnow, fathead minnow, black crappie
Cyclonaias pustulosa	pimpleback		black bullhead, brown bullhead, channel catfish, white crappie, flathead catfish, shovelnose sturgeon
Cyclonaias tuberculata	purple wartyback		black bullhead, yellow bullhead, channel catfish, flathead catfish
Cyprogenia stegaria	fanshell	Fed. Endangered	mottled sculpin, banded sculpin, snubnose darter, banded darter, tangerine darter, greenside darter, blotchside logperch, logperch, Roanoke darter

Ellipsaria lineolata	butterfly		freshwater drum, green sunfish, sauger
Elliptio complanata	eastern elliptio		American eel, brook trout, lake trout, mottled sculpin, slimy sculpin
Elliptio crassidens	elephant ear		skipjack herring
Elliptio fisheriana	northern lance	state candidate	no known hosts
Elliptio producta	Atlantic spike	state candidate	no known hosts
Epioblasma rangiana	northern riffleshell	Fed. Endangered	mottled sculpin, banded sculpin, rainbow darter, Iowa darter, bluebreast darter, Johnny darter, banded darter, brown trout
Epioblasma triquetra	snuffbox	Fed. Endangered	mottled sculpin, banded sculpin, black sculpin, Ozark sculpin, blackspotted topminnow, logperch, blackside darter, Roanoke darter
Eurynia dilatata	spike		rock bass, banded sculpin, gizzard shad, rainbow darter, yellow perch, white crappie, black crappie, flathead catfish, sauger
Fusconaia flava	wabash pigtoe		bluegill, silver shiner, white crappie, black crappie, creek chub
Fusconaia subrotunda	longsolid		no known hosts
Hemistena lata	cracking pearlymussel	Fed. Endangered	no known hosts
Lampsilis abrupta	pink mucket	Fed. Endangered	smallmouth bass, spotted bass, largemouth bass, walleye
Lampsilis cardium	plain pocketbook		tiger salamander, green sunfish, pumpkinseed, bluegill, smallmouth bass, largemouth bass, yellow perch
Lampsilis cariosa	yellow lampmussel		white perch, yellow perch
Lampsilis fasciola	wavy-rayed lampmussel		longear sunfish, smallmouth bass, largemouth bass, bluntnose minnow
Lampsilis ovata	pocketbook		may be confused with L. cardium hosts.
Lampsilis radiata	eastern lampmussel	state candidate	rock bass, pumpkinseed, bluegill, longear sunfish, smallmouth bass, largemouth bass, white perch
Lampsilis siligoidea	fatmucket		rock bass, white sucker, warmouth, Florida gar, green sunfish, pumpkinseed, bluegill, longear sunfish, common shiner, smallmouth bass, largemouth bass, white bass, sand shiner, tadpole madtom, yellow perch, bluntnose minnow, white crappie, black crappie, sauger, walleye
Lasmigona complanata	white heelsplitter		common carp, gizzard shad, banded sunfish, longnose gar, green sunfish, orangespotted sunfish, longear sunfish, largemouth bass, river redhorse, yellow perch, white crappie, black crappie, sauger
Lasmigona compressa	creek heelsplitter		black bullhead, yellow bullhead, slimy sculpin, brook stickleback, spotfin shiner, gizzard shad, brassy minnow, shortnose gar, green sunfish, orange-spotted sunfish, bluegill, smallmouth bass, emerald shiner, mimic shiner, yellow perch, black crappie, flathead catfish, longnose dace, creek chub

			rock bass, brown bullhead, bowfin, central stoneroller, goldfish, banded sculpin, common carp, gizzard shad, northern pike, rainbow darter, fantail darter, variegate darter, northern studfish, banded darter, green sunfish, pumpkinseed, bluegill, longear sunfish, smallmouth bass, largemouth bass, river redhorse, yellow perch, longnose dace, walleye, creek chub
Lasmigona costata	flutedshell		
Lasmigona subviridis	green floater		no known hosts. Hermaphroditic.
Leptodea fragilis	fragile papershell		freshwater drum
Leptodea ochracea	tidewater mucket		white perch
Ligumia nasuta	eastern pondmussel		no known hosts
Ligumia recta	black sandshell		rock bass, American eel, central stoneroller, common carp, banded killifish, redbreast sunfish, green sunfish, pumpkinseed, orangespotted sunfish, bluegill, longear sunfish, largemouth bass, white perch, rosyface shiner, yellow perch, white crappie, black crappie, sauger, walleye
Margaritifera margaritifera	eastern pearlshell		rainbow trout, brown trout, brook trout
Obliquaria reflexa	threehorn wartyback		silverjaw minnow, common shiner, longnose dace
Obovaria olivaria	hickorynut		lake sturgeon, shovelnose sturgeon
Obovaria retusa	ring pink		no known hosts
Obovaria subrotunda	round hickorynut	state endangered	banded sculpin, emerald darter, greenside darter, fantail darter, speckled darter, longhunt darter, spangled darter, variegate darter, frecklebelly darter
Plethobasus cooperianus	orangefoot pimpleback	Fed. Endangered	no known hosts
Plethobasus cyphus	sheepnose	Fed. Endangered	central stoneroller, sauger
Pleurobema clava	clubshell	Fed. Endangered	central stoneroller, striped shiner, logperch, blackside darter
Pleurobema cordatum	Ohio pigtoe		brook stickleback, rosefin shiner, bluegill, creek chub
Pleurobema plenum	rough pigtoe	Fed. Endangered	no known hosts
Pleurobema rubrum	pyramid pigtoe		spotfin shiner, streamline chub, scarlet shiner, silver shiner
Pleurobema sintoxia	round pigtoe		central stoneroller, spotfin shiner, bluegill, northern redbelly dace, southern redbelly dace, bluntnose minnow
Potamilus alatus	pink heelsplitter		freshwater drum
Potamilus ohioensis	pink papershell		freshwater drum, white crappie
Ptychobranhus fasciolaris	kidneyshell		brook stickleback, rainbow darter, fantail darter
Pyganodon cataracta	eastern floater		white sucker, common carp, threespine stickleback, pumpkinseed, bluegill, yellow perch



			skipjack herring, rock bass, yellow bullhead, freshwater drum, central stoneroller, river carpsucker, goldfish, white sucker, brook stickleback, common carp, gizzard shad, rainbow darter, Iowa darter, Johnny darter, golden topminnow, banded killifish, brook silverside, longnose gar, green sunfish, pumpkinseed, orangespotted sunfish, bluegill, longear sunfish, striped shiner, commone shiner, largemouth bass, redbfin shiner, pearl dace, white bass, round goby, golden shiner, blackchin shiner, blacknose shiner, yellow perch, bluntnose minnow, white crappie, black crappie, blacknose dace, creek chub
Pyganodon grandis	giant floater		
Quadrula quadrula	mapleleaf		channel catfish, flathead catfish
Simpsonaias ambigua	salamander mussel	state endangered	mudpuppy
			rock bass, black bullhead, yellow bullhead, central stoneroller, brook stickleback, rainbow darter, Iowa darter, Johnny darter, fantail darter, slenderhead darter, banded darter, plains killifish, channel catfish, green sunfish, pumpkinseed, bluegill, longear sunfish, burbot, commone shiner, largemouth bass, smallmouth bass, common shiner, sand shiner, river chub, yellow perch, logperch, bluntnose minnow, white crappie, black crappie, blacknose dace, blackside darter, northern redbelly dace, bluntnose minnow, fathead minnow
Strophitus undulatus	creeper		
Theliderma cylindrica	rabbitsfoot	state endangered Fed. Threatened	rainbow darter, striped shiner
Theliderma metanevra	monkeyface		spotfin shiner, creek chub, green sunfish, bluntnose minnow, blacknose dace, sauger
Toxolasma parvum	lilliput		Johnny darter, green sunfish, warmouth, orangespotted sunfish, bluegill, white crappie
Tritogonia verrucosa	pistolgrip	state endangered	yellow bullhead, brown bullhead, channel catfish, flathead catfish
Truncilla donaciformis	fawnsfoot		freshwater drum, sauger
Truncilla truncata	deertoe		freshwater drum, sauger
			rock bass, tiger salamander, goldfish, white sucker, brook stickleback, common carp, gizzard shad, greenthroat darter, banded killifish, mosquitofish, channel catfish, green sunfish, pumpkinseed, warmouth, bluegill, dollar sunfish, longear sunfish, largemouth bass, golden shiner, yellow perch, black crappie, creek chub
Utterbackia imbecillis	paper pondshell		
Utterbackiana implicata	alewife floater		alewife, American shad, blueback herring, white sucker, threespine stickleback, pumpkinseed, white perch
Utterbackiana suborbiculata	flat floater		channel catfish, green sunfish, warmouth, longear sunfish, largemouth bass, golden shiner, white crappie

Villosa fabalis	rayed bean	Fed. Endangered	mottled sculpin, greenside darter, rainbow darter, Tippecanoe darter, largemouth bass, logperch
Villosa iris	rainbow		mottled sculpin, streamline chub, greenside darter, rainbow darter, bluebreast darter, green sunfish, striped shiner, smallmouth bass, largemouth bass, yellow perch

Fed. Endangered
Fed. Candidate
State Endangered
State Candidate
State Endangered, Fed. Threatened



*The below table can be sorted by fish species, common names or scientific names (see the table below this one for sorting by mussel species):*

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**Fish Species (Common Name)**

Alewife

American eel

American shad

banded darter

banded killifish

banded sculpin

banded sunfish

black bullhead

black crappie

black redhorse

black sculpin

blackchin shiner

blacknose dace

blacknose shiner

blackside darter

blackspotted topminnow

blotchside logperch

blueback herring

bluebreast darter

bluegill

bluntnose minnow

bowfin

brassy minnow

brook silverside

brook stickleback

brook trout

brown bullhead

brown trout

central mudminnow

## PA Freshwater Mussel Species and Fish Host(s)

Fish Species (below), Mussel Species (right)	Mucket ( <i>Actinonaias ligamentina</i> )	Dwarf wedgemussel ( <i>Alasmodonta heterodon</i> )	Elktoe ( <i>Alasmodonta marginata</i> )
<i>Alosa pseudoharengus</i>			
<i>Anguilla rostrata</i>	x		
<i>Alosa sapidissima</i>			
<i>Etheostoma zonale</i>			
<i>Fundulus diaphanus</i>	x	x	
<i>Cottus carolinae</i>			
<i>Enneacanthus obesus</i>			
<i>Ameiurus melas</i>			
<i>Pomoxis nigromaculatus</i>	x		
<i>Moxostoma duquesnei</i>			
<i>Cottus baileyi</i>			
<i>Notropis heterodon</i>			
<i>Rhinichthys atratulus</i>	x		
<i>Notropis heterolepis</i>			
<i>Percina maculata</i>			
<i>Fundulus olivaceus</i>			
<i>Percina burtoni</i>			
<i>Alosa aestivalis</i>			
<i>Etheostoma camurum</i>			
<i>Lepomis macrochirus</i>	x		
<i>Pimephales notatus</i>			
<i>Amia calva</i>			
<i>Hybognathus hankinsoni</i>			
<i>Labidesthes sicculus</i>			
<i>Culaea inconstans</i>			
<i>Salvelinus fontinalis</i>			
<i>Ameiurus nebulosus</i>			
<i>Salmo trutta</i>		x	
<i>Umbra limi</i>			

Triangle floater ( <i>Alasmidonta undulata</i> )	Brook floater ( <i>Alasmidonta varicosa</i> )	Threeridge ( <i>Amblema plicata</i> )	Cylindrical papershell ( <i>Anodontoides ferussacianus</i> )	Pimpleback ( <i>Cyclonaias pustulosa</i> )
				X
		X	X	
		X		
X	X			
			X	
X				
		X	X	
			X	
			X	
				X



Northern lance ( <i>Elliptio fisheriana</i> )	Atlantic spike ( <i>Elliptio producta</i> )	Northern riffleshell ( <i>Epioblasma rangiana</i> )	Snuffbox ( <i>Epioblasma triquetra</i> )	Spike ( <i>Eurynia dilatata</i> )	Wabash pigtoe ( <i>Fusconaia flava</i> )
		x			
		x	x	x	
				x	x
			x		
			x		
			x		
		x			
					x
		x			



Wavy-rayed lampmussel ( <i>Lampsilis fasciola</i> )	Pocketbook ( <i>Lampsilis ovata</i> )	Eastern lampmussel ( <i>Lampsilis radiata</i> )	Fatmucket ( <i>Lampsilis siliquoidea</i> )	White heelsplitter ( <i>Lasmigona complanata</i> )
				x
		x	x	x
		x	x	
x		x	x	







Ring pink ( <i>Obovaria retusa</i> )	Round hickorynut ( <i>Obovaria subrotunda</i> )	Orangefoot pimpleback ( <i>Plethobasus cooperianus</i> )	Sheepnose ( <i>Plethobasus cyphus</i> )	Clubshell ( <i>Pleurobema clava</i> )
	x			
				x





Salamander mussel ( <i>Simpsonaias ambigua</i> )	Creeper ( <i>Strophitus undulatus</i> )	Rabbitsfoot ( <i>Theliderma cylindrica</i> )	Monkeyface ( <i>Theliderma metanevra</i> )	Lilliput ( <i>Toxolasma parvum</i> )
	X			
	X			
	X			
	X		X	
	X			
	X		X	X
	X		X	
	X			
	X			

Pistolgrip ( <i>Tritogonia verrucosa</i> )	Fawnsfoot ( <i>Truncilla donaciformis</i> )	Deertoe ( <i>Truncilla truncata</i> )	Paper pondshell ( <i>Utterbackia imbecillis</i> )	Alewife floater ( <i>Utterbackiana implicata</i> )
				x
				x
			x	
			x	
				x
			x	
			x	
x				

Flat floater ( <i>Utterbackiana suborbiculata</i> )	Rayed bean ( <i>Villosa fabalis</i> )	Rainbow ( <i>Villosa iris</i> )
		x

















central stoneroller

channel catfish

common carp

common shiner

creek chub

dollar sunfish

emerald darter

emerald shiner

fallfish

fantail darter

fathead minnow

flathead catfish

frecklebelly darter

freshwater drum

gizzard shad

golden redhorse

golden shiner

golden topminnow

green sunfish

greenside darter

greenthroat darter

iowa darter

johnny darter

lake sturgeon

lake trout

largemouth bass

logperch

longear sunfish

longhunt darter

longnose dace

longnose gar

marginated madtom

mimic shiner

mooneye

<i>Campostoma anomalum</i>	x
<i>Ictalurus punctatus</i>	
<i>Cyprinus carpio</i>	x
<i>Luxilus cornutus</i>	
<i>Semotilus atromaculatus</i>	x
<i>Lepomis marginatus</i>	
<i>Etheostoma baileyi</i>	
<i>Notropis atherinoides</i>	
<i>Semotilus corporalis</i>	
<i>Etheostoma flabellare</i>	
<i>Pimephales promelas</i>	
<i>Pylodictis olivaris</i>	
<i>Percina stictogaster</i>	
<i>Aplodinotus grunniens</i>	
<i>Dorosoma cepedianum</i>	
<i>Moxostoma erythrurum</i>	
<i>Notemigonus crysoleucas</i>	
<i>Fundulus chrysotus</i>	
<i>Lepomus cyanellus</i>	x
<i>Etheostoma blennioides</i>	
<i>Etheostoma lepidum</i>	
<i>Etheostoma exile</i>	
<i>Etheostoma nigrum</i>	
<i>Acipenser fulvescens</i>	
<i>Salvelinus namaycush</i>	
<i>Micropterus salmoides</i>	x
<i>Percina caprodes</i>	
<i>Lepomis megalotis</i>	
<i>Etheostoma stigmaeum</i>	
<i>Rhinichthys cataractae</i>	
<i>Lepisosteus osseus</i>	
<i>Noturus insignis</i>	
<i>Notropis volucellus</i>	
<i>Hiodon tergisus</i>	





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mudpuppy  
mottled sculpin  
norther hogsucker  
northern pike  
northern redbelly dace  
northern studfish  
orangespotted sunfish  
Ozark sculpin  
pearl dace  
plains killifish  
pumpkinseed  
rainbow darter  
rainbow trout  
redbreast sunfish  
redfin shiner  
river carsucker  
river chub  
river redhorse  
Roanoke darter  
rock bass  
rosefin shiner  
rosyface shiner  
sand shiner  
sauger  
scarlet shiner  
sea lamprey  
shield darter  
Shorthead redhorse  
shortnose gar  
shovelnose sturgeon  
silver shiner  
silverjaw minnow  
silverside stickleback  
skipjack herring/shad

<i>Necturus maculosus</i>			
<i>Cottus bairdii</i>		x	
<i>Hypentelium nigricans</i>			x
<i>Esox lucius</i>			
<i>Chrosomus eos</i>			
<i>Fundulus catenatus</i>			
<i>Lepomis humilis</i>	x		
<i>Cottus hypselurus</i>			
<i>Margariscus margarita</i>			
<i>Fundulus zebrinus</i>			
<i>Lepomis gibbosus</i>			
<i>Etheostoma caeruleum</i>			
<i>Oncorhynchus mykiss</i>			
<i>Lepomis auritus</i>			
<i>Lythrurus umbratilis</i>			
<i>Carpionodes carpio</i>			
<i>Nocomis micropogon</i>			
<i>Moxostoma carinatum</i>			
<i>Percina roanoka</i>			
<i>Ambloplites rupestris</i>			x
<i>Lythrurus ardens</i>			
<i>Notropis rubellus</i>			
<i>Notropis stramineus</i>			
<i>Sander canadensis</i>	x		
<i>Lythrurus fasciolaris</i>			
<i>Petromyzon marinus</i>			
<i>Percina peltata</i>		x	
<i>Moxostoma macrolepidotum</i>			x
<i>Lepisosteus platostomus</i>			
<i>Scaphirhynchus platyrhynchus</i>			
<i>Notropis photogenis</i>			
<i>Notropis buccatus</i>	x		
<i>unknown scientific name</i>			
<i>Alosa chrysochloris</i>			

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slenderhead darter  
slimy sculpin  
smallmouth bass  
snubnose darter  
southern redbelly dace  
spangled darter  
speckled darter  
spotfin shiner  
spotted bass  
steelcolor shiner  
streamline chub  
striped bass  
striped shiner  
tadpole madtom  
tangerine darter  
tessallated darter  
threespine stickleback  
tiger salamander  
tippecanoe darter  
variegate darter  
walleye  
warmouth  
white bass  
white crappie  
white perch  
white sucker  
yellow bullhead  
yellow perch

Fed. Endangered  
Fed. Candidate  
State Endangered  
State Candidate

<i>Percina phoxocephala</i>		
<i>Cottus cognatus</i>		x
<i>Micropterus dolomeiu</i>	x	
<i>Etheostoma simoterum</i>		
<i>Chrosomus erythrogaster</i>		
<i>Etheostoma caeruleum</i>		
<i>Etheostoma stigmaeum</i>		
<i>Cyprinella spiloptera</i>		
<i>Micropterus punctulatus</i>		
<i>Cyprinella whipplei</i>		
<i>Erimystac dissimilis</i>		
<i>Morone saxatilis</i>		x
<i>Luxilus chrysocephalus</i>		
<i>Noturus gyrinus</i>	x	
<i>Percina aurantiaca</i>		
<i>Etheostoma olmsted</i>		x
<i>Gasterosteus aculeatus</i>		
<i>Ambystoma tigrinum</i>		
<i>Etheostoma tippecanoe</i>	x	
<i>Etheostoma variatum</i>		
<i>Sander vitreus</i>		
<i>Lepomis gulosus</i>		x
<i>Morone chrysops</i>	x	
<i>Pomoxis annularis</i>	x	
<i>Morone americana</i>		
<i>Catostomus commersonii</i>		x
<i>Ameiurus natalis</i>		
<i>Perca flavescens</i>	x	



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State Endangered, Fed. Threatened

*The below table can be sorted by mussel species, common names or scientific names (see the table above for sorting by fish species):*

**Mussel Species (Common Name)**

Mucket

Dwarf wedgemussel

Elktoe

Triangle floater

Brook floater

Threeridge

Cylindrical papershell

Pimpleback

Purple wartyback

Fanshell

Butterfly

Eastern elliptio

Elephant ear

Northern lance

Atlantic spike

Northern riffleshell

Snuffbox

Spike

Wabash pigtoe

Longsolid

Cracking pearlymussel

Pink mucket

Plain pocketbook

Yellow lampmussel

Wavy-rayed lampmussel

Mussel Species (below), Fish Species (right)	Alewife ( <i>Alosa pseudoharengus</i> )	American eel ( <i>Anguilla rostrata</i> )	American shad ( <i>Alosa sapidissima</i> )
<i>Actinonaias ligamentina</i>		x	
<i>Alasmidonta heterdon</i>			
<i>Alasmidonta marginata</i>			
<i>Alasmidonta undulata</i>			
<i>Alasmidonta varicosa</i>			
<i>Amblema plicata</i>			
<i>Anodontoides ferussacianus</i>			
<i>Cyclonaias pustulosa</i>			
<i>Cyclonaias tuberculata</i>			
<i>Cyprogenia stegaria</i>			
<i>Ellipsaria lineolata</i>			
<i>Elliptio complanata</i>	x		
<i>Elliptio crassidens</i>			
<i>Elliptio fisheriana</i>			
<i>Elliptio producta</i>			
<i>Epioblasma rangiana</i>			
<i>Epioblasma triquetra</i>			
<i>Eurynia dilatata</i>			
<i>Fusconaia flava</i>			
<i>Fusconaia subrotunda</i>			
<i>Hemistena lata</i>			
<i>Lampsilis abrupta</i>			
<i>Lampsilis cardium</i>			
<i>Lampsilis cariosa</i>			
<i>Lampsilis fasciola</i>			

banded darter (Etheostoma zonale)	banded killifish (Fundulus diaphanus)	banded sculpin (Cottus carolinae)	banded sunfish (Enneacanthus obesus)	black bullhead (Ameiurus melas)
	x			
	x			
				x
				x
x		x		
x		x		
		x		
		x		

black crappie (Pomoxis nigromaculatus)	black redhorse (Moxostoma duquesnei)	black sculpin (Cottus baileyi)	blackchin shiner (Notropis heterodon)	blacknose dace (Rhinichthys atratulus)
x				x
				x
				x
x	x			
x				
		x		
x				
x				
x				

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blacknose shiner (Notropis heterolepis)	blackside darter (Percina maculata)	blackspotted topminnow (Fundulus olivaceus)	blotchside logperch (Percina burtoni)	blueback herring (Alosa aestivalis)	bluebreast darter (Etheostoma camurum)
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x

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bluegill (Lepomis machrochirus)	bluntnose minnow (Pimephales notatus)	bowfin (Amia calva)	brassy minnow (Hybognathus hankinsoni)	brook silverside (Labidesthes sicculus)
x				
x				
x	x			
x				
x				
	x			

brook stickleback (Culaea inconstans)	brook trout (Salvelinus fontinalis)	brown bullhead (Ameiurus nebulosus)	brown trout (Salmo trutta)	central mudminnow (Umbra limi)
			x	
x				
		x		
	x			
			x	

central stoneroller (Campostoma anomalum)	channel catfish (Ictalurus punctatus)	common carp (Cyprinus carpio)	common shiner (Luxilus cornutus)	creek chub (Semotilus atromaculatus)
x		x		x
x			x	
	x			
			x	
	x			
	x			
				x



dollar sunfish (Lepomis marginatus)	emerald darter (Etheostoma baileyi)	emerald shiner (Notropis atherinoides)	fallfish (Semotilus corporalis)	fantail darter (Etheostoma flabellare)
			x	x
		x		

fathead minnow (Pimephales promelas)	flathead catfish (Pylodictis olivaris)	frecklebelly darter (Percina stictogaster)	freshwater drum (Aplodinotus grunniens)	gizzard shad (Dorosoma cepedianum)
	X		X	
X				
	X			
	X			
			X	
	X			X

golden redhorse (Moxostoma erythrurum)	golden shiner (Notemigonus crysoleucas)	golden topminnow (Fundulus chrysotus)	green sunfish (Lepomus cyanellus)	greenside darter (Etheostoma blennioides)
			x	
	x			
x			x	
				x
			x	
			x	

greenthroat darter (Etheostoma lepidum)	Iowa darter (Etheostoma exile)	Johnny darter (Etheostoma nigrum)	lake sturgeon (Acipenser fulvescens)	lake trout (Salvelinus namaycush)
	x			
				x
	x	x		

largemouth bass (Micropterus salmoides)	logperch (Percina caprodes)	longear sunfish (Lepomis megalotis)	longhunt darter (Etheostoma stigmaeum)	longnose dace (Rhinichthys cataractae)
x				
x				x
				x
x	x			
x				
	x			
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x				
x		x		

longnose gar (Lepisosteus osseus)	marginated madtom (Noturus insignis)	mimic shiner (Notropis volucellus)	mooneye (Hiodon tergisus)	mudpuppy (Necturus maculosus)
	x			
			x	

mottled sculpin (Cottus bairdii)	norther hogsucker (Hypentelium nigricans)	northern pike (Esox lucius)	northern redbelly dace (Chrosomus eos)	northern studfish (Fundulus catenatus)	orangespotted sunfish (Lepomis humilis)	Ozark sculpin (Cottus hypselurus)
					x	
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	x					
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x						x

pearl dace (Margariscus margarita)	plains killifish (Fundulus zebrinus)	pumpkinseed (Lepomis gibbosus)	rainbow darter (Etheostoma caeruleum)	rainbow trout (Oncorhynchus mykiss)	redbreast sunfish (Lepomis auritus)	redfin shiner (Lythrurus umbratilis)	river carpsucker (Carpiodes carpio)
		x					
		x					
		x					
			x				
			x				
		x					



river chub (Nocomis micropogon)	river redhorse (Moxostoma carinatum)	Roanoke darter (Percina roanoka)	rock bass (Ambloplites rupestris)	rosefin shiner (Lythrurus ardens)	rosyface shiner (Notropis rubellus)	sand shiner (Notropis stramineus)	sauger (Sander canadensis)
							x
			x				
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			x				x
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							x

scarlet shiner (Lythrurus fasciolaris)	sea lamprey (Petromyzon marinus)	shield darter (Percina peltata)	Shorthead redhorse (Moxostoma macrolepidotum)	shortnose gar (Lepisosteus platostomus)	shovelnose sturgeon (Scaphirhynchus platyrhynchus)	silver shiner (Notropis photogenis)	silverjaw minnow (Notropis buccatus)
							x
		x					
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				x			
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					x		
						x	

<b>silverside stickleback (unknown scientific name)</b>	<b>skipjack herring/shad (Alosa chrysochloris)</b>	<b>slenderhead darter (Percina phoxocephala)</b>	<b>slimy sculpin (Cottus cognatus)</b>	<b>smallmouth bass (Micropterus dolomeiu)</b>	<b>snubnose darter (Etheostoma simoterum)</b>	<b>southern redbelly dace (Chrosomus erythrogaster)</b>	<b>spangled darter (Etheostoma caeruleum)</b>
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tangerine darter (Percina aurantiaca)	tessallated darter (Etheostoma olmstedii)	threespine stickleback (Gasterosteus aculeatus)	tiger salamander (Ambystoma tigrinum)	tippecanoe darter (Etheostoma tippecanoe)	variegate darter (Etheostoma variatum)	walleye (Sander vitreus)	warmouth (Lepomis gulosus)
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	x						
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						x	
			x			x	

white bass (Morone chrysops)	white crappie (Pomoxis annularis)	white perch (Morone americana)	white sucker (Catostomus commersonii)	yellow bullhead (Ameiurus natalis)	yellow perch (Perca flavescens)
x	x				x
			x		
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Pocketbook

Eastern lampmussel

Fatmucket

White heelsplitter

Creek heelsplitter

Flutedshell

Green floater

Fragile papershell

Tidewater mucket

Eastern pondmussel

Black sandshell

Eastern pearlshell

Threehorn wartyback

Hickorynut

Ring pink

Round hickorynut

Orangefoot pimpleback

Sheepnose

Clubshell

Ohio pigtoe

Rough pigtoe

Pyramid pigtoe

Round pigtoe

Pink heelsplitter

Pink papershell

Kidneyshell

Eastern floater

Giant floater

Mapleleaf

Salamander mussel

Creeper

Rabbitsfoot

Monkeyface

Lilliput

<i>Lampsilis ovata</i>	
<i>Lampsilis radiata</i>	
<i>Lampsilis siliquoidea</i>	
<i>Lasmigona complanata</i>	
<i>Lasmigona compressa</i>	
<i>Lasmigona costata</i>	
<i>Lasmigona subviridis</i>	
<i>Leptodea fragilis</i>	
<i>Leptodea ochracea</i>	
<i>Ligumia nasuta</i>	
<i>Ligumia recta</i>	x
<i>Margaritifera margaritifera</i>	
<i>Obliquaria reflexa</i>	
<i>Obovaria olivaria</i>	
<i>Obovaria retusa</i>	
<i>Obovaria subrotunda</i>	
<i>Plethobasus cooperianus</i>	
<i>Plethobasus cyphyus</i>	
<i>Pleurobema clava</i>	
<i>Pleurobema cordatum</i>	
<i>Pleurobema plenum</i>	
<i>Pleurobema rubrum</i>	
<i>Pleurobema sintoxia</i>	
<i>Potamilus alatus</i>	
<i>Potamilus ohioensis</i>	
<i>Ptychobranhus fasciolaris</i>	
<i>Pyganodon cataracta</i>	
<i>Pyganodon grandis</i>	
<i>Quadrula quadrula</i>	
<i>Simpsonaias ambigua</i>	
<i>Strophitus undulatus</i>	
<i>Theliderma cylindrica</i>	
<i>Theliderma metanevra</i>	
<i>Toxolasma parvum</i>	



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This image shows a single sheet of white paper with horizontal blue or grey ruling lines. There are three small black 'x' marks placed vertically down the center of the page, likely indicating where to fold the paper into quarters. The first 'x' is located approximately one-third of the way down from the top edge. The second 'x' is located at the vertical midpoint of the page. The third 'x' is located approximately two-thirds of the way down from the top edge. The background behind the paper is dark and textured.

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A diagram showing a horizontal line with a point labeled 'x' on it. The line is divided into two segments by point 'x'. The left segment is labeled 'a' and the right segment is labeled 'b'.

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Pistolgrip

Fawnsfoot

Deertoe

Paper pondshell

Alewite floater

Flat floater

Rayed bean

Rainbow



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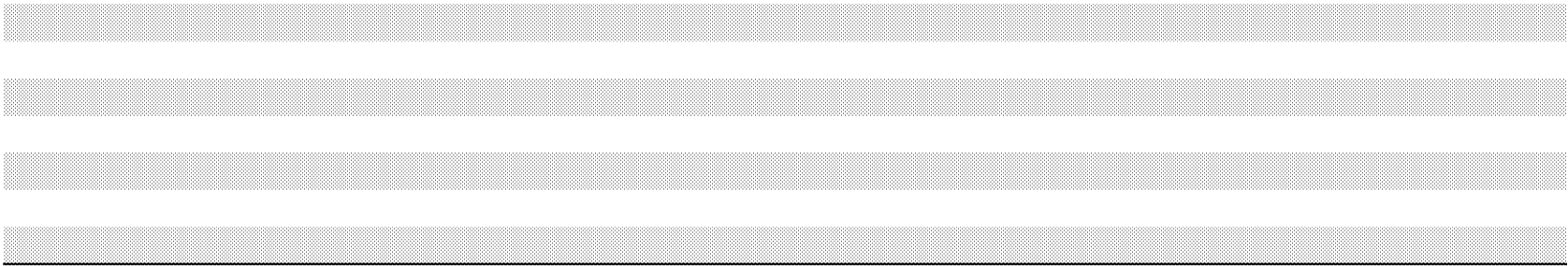
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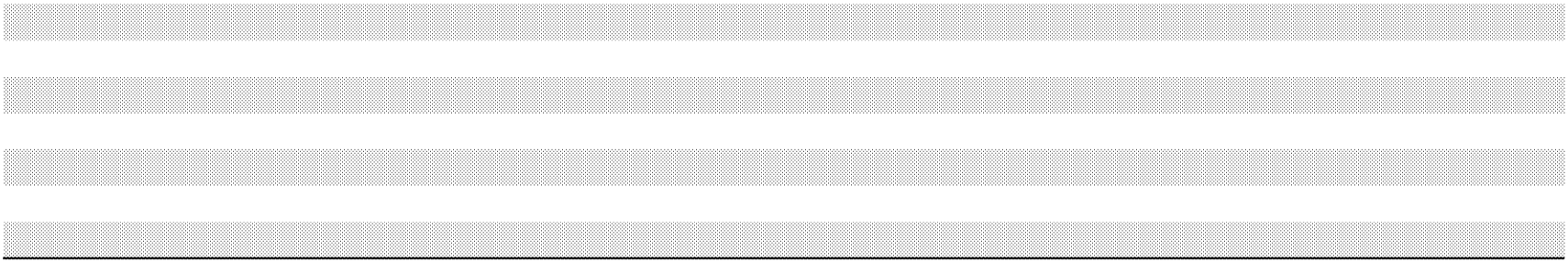
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**Migratory Fish in Pennsylvania**

River herring (Alewife and Blueback herring)

Alewife	<i>Alosa pseudoharengus</i>
American shad	<i>Alosa sapidissima</i>
Blueback herring	<i>Alosa aestivalis</i>
Hickory shad	<i>Alosa mediocris</i>
Gizzard shad	<i>Dorosoma cepedianum</i>
Atlantic sturgeon	<i>Acipenser oxyrhynchus oxyrhynchus</i>
Shortnose sturgeon	<i>Acipenser brevirostrum</i>
American eel	<i>Anguilla rostrata</i>
Stripped bass	<i>Morone saxatilis</i>

Fed. Endangered
Fed. Candidate
State Endangered
State Candidate
State Endangered, Fed. Threatened
State Endangered, Fed. Endangered

Scientific Name	Common Name	Species Group
<i>Acanthorutilus handlirschi</i>	Cicek minnow	Fishes
<i>Acipenser brevirostrum</i>	Shortnose sturgeon	Fishes
<i>Acipenser medirostris</i>	green sturgeon	Fishes
<i>Acipenser mikadoi</i>	Sakhalin sturgeon	Fishes
<i>Acipenser naccarii</i>	Adriatic sturgeon	Fishes
<i>Acipenser oxyrinchus desotoi</i>	Atlantic sturgeon (Gulf subspecies)	Fishes
<i>Acipenser oxyrinchus oxyrinchus</i>	Atlantic sturgeon	Fishes
<i>Acipenser oxyrinchus oxyrinchus</i>	Atlantic sturgeon	Fishes
<i>Acipenser oxyrinchus oxyrinchus</i>	Atlantic sturgeon	Fishes
<i>Acipenser oxyrinchus oxyrinchus</i>	Atlantic sturgeon	Fishes
<i>Acipenser oxyrinchus oxyrinchus</i>	Atlantic sturgeon	Fishes
<i>Acipenser sinensis</i>	Chinese sturgeon	Fishes
<i>Acipenser sturio</i>	European sturgeon	Fishes
<i>Acipenser transmontanus</i>	White sturgeon	Fishes
<i>Amblyopsis rosae</i>	Ozark cavefish	Fishes
<i>Anoxypristis cuspidata</i>	Narrow sawfish	Fishes
<i>Catostomus discobolus yarrowi</i>	Zuni bluehead Sucker	Fishes
<i>Catostomus santaanae</i>	Santa Ana sucker	Fishes
<i>Catostomus warnerensis</i>	Warner sucker	Fishes
<i>Chasmistes brevirostris</i>	Shortnose Sucker	Fishes
<i>Chasmistes cujus</i>	Cui-ui	Fishes
<i>Chasmistes liorus</i>	June sucker	Fishes
<i>Chrosomus saylari</i>	Laurel dace	Fishes
<i>Coreobagrus ichikawai</i>	Nekogigi catfish	Fishes
<i>Cottus paulus pygmaeus</i>	Pygmy Sculpin	Fishes
<i>Cottus specus</i>	Grotto Sculpin	Fishes
<i>Crenichthys baileyi baileyi</i>	White River springfish	Fishes
<i>Crenichthys baileyi grandis</i>	Hiko White River springfish	Fishes
<i>Crenichthys nevadae</i>	Railroad Valley springfish	Fishes
<i>Crystallaria cincotta</i>	diamond Darter	Fishes
<i>Cynoscion macdonaldi</i>	Totoaba (seatrout or weakfish)	Fishes
<i>Cyprinella caerulea</i>	Blue shiner	Fishes
<i>Cyprinella formosa</i>	Beautiful shiner	Fishes
<i>Cyprinodon bovinus</i>	Leon Springs pupfish	Fishes
<i>Cyprinodon diabolis</i>	Devils Hole pupfish	Fishes
<i>Cyprinodon elegans</i>	Comanche Springs pupfish	Fishes
<i>Cyprinodon macularius</i>	Desert pupfish	Fishes
<i>Cyprinodon nevadensis mionectes</i>	Ash Meadows Amargosa pupfish	Fishes
<i>Cyprinodon nevadensis pectoralis</i>	Warm Springs pupfish	Fishes
<i>Cyprinodon radiosus</i>	Owens pupfish	Fishes
<i>Deltistes luxatus</i>	Lost River sucker	Fishes
<i>Dionda diaboli</i>	Devils River minnow	Fishes
<i>Elassoma alabamae</i>	Spring pygmy sunfish	Fishes
<i>Empetrichthys latos</i>	Pahrump poolfish	Fishes

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**Federal Listing Status**

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Endangered

Endangered

Threatened

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**Where Listed**

Wherever found

Wherever found

Southern DPS - See 50 CFR 223.102

Wherever found

Wherever found

Wherever found

Carolina DPS - See 50 CFR 224.101

Chesapeake Bay DPS - See 50 CFR 224.101

New York Bight DPS - See 50 CFR 224.101

South Atlantic DPS - See 50 CFR 224.101

Gulf of Maine DPS - See 50 CFR 223.102

Wherever found

Wherever found

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Wherever found

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Los Angeles River basin, San Gabriel River basin, Santa Ana River basin

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<i>Epinephelus striatus</i>	Nassau grouper	Fishes
<i>Eremichthys acros</i>	Desert dace	Fishes
<i>Erimonax monachus</i>	Spotfin Chub	Fishes
<i>Erimonax monachus</i>	Spotfin Chub	Fishes
<i>Erimonax monachus</i>	Spotfin Chub	Fishes
<i>Erimonax monachus</i>	Spotfin Chub	Fishes
<i>Erimystax cahni</i>	Slender chub	Fishes
<i>Erimystax cahni</i>	Slender chub	Fishes
<i>Etheostoma akatulo</i>	bluemask darter	Fishes
<i>Etheostoma boschungii</i>	Slackwater darter	Fishes
<i>Etheostoma chermocki</i>	Vermilion darter	Fishes
<i>Etheostoma chienense</i>	Relict darter	Fishes
<i>Etheostoma etowahae</i>	Etowah darter	Fishes
<i>Etheostoma fonticola</i>	Fountain darter	Fishes
<i>Etheostoma moorei</i>	Yellowcheek Darter	Fishes
<i>Etheostoma nianguae</i>	Niangua darter	Fishes
<i>Etheostoma nuchale</i>	Watercress darter	Fishes
<i>Etheostoma okaloosae</i>	Okaloosa darter	Fishes
<i>Etheostoma osburni</i>	Candy darter	Fishes
<i>Etheostoma percnurum</i>	Duskytail darter	Fishes
<i>Etheostoma percnurum</i>	Duskytail darter	Fishes
<i>Etheostoma percnurum</i>	Duskytail darter	Fishes
<i>Etheostoma phytophilum</i>	Rush Darter	Fishes
<i>Etheostoma rubrum</i>	Bayou darter	Fishes
<i>Etheostoma scotti</i>	Cherokee darter	Fishes
<i>Etheostoma sellare</i>	Maryland darter	Fishes
<i>Etheostoma spilotum</i>	Kentucky arrow darter	Fishes
<i>Etheostoma susanae</i>	Cumberland darter	Fishes
<i>Etheostoma trisella</i>	Trispot darter	Fishes
<i>Etheostoma wapiti</i>	Boulder darter	Fishes
<i>Etheostoma wapiti</i>	Boulder darter	Fishes
<i>Eucyclogobius newberryi</i>	Tidewater goby	Fishes
<i>Fundulus julisia</i>	Barrens topminnow	Fishes
<i>Gambusia gaigei</i>	Big Bend gambusia	Fishes
<i>Gambusia georgei</i>	San Marcos gambusia	Fishes
<i>Gambusia heterochir</i>	Clear Creek gambusia	Fishes
<i>Gambusia nobilis</i>	Pecos gambusia	Fishes
<i>Gasterosteus aculeatus williamsoni</i>	Unarmored threespine stickleback	Fishes
<i>Gila bicolor ssp.</i>	Hutton tui chub	Fishes
<i>Gila bicolor ssp. mohavensis</i>	Mohave tui chub	Fishes
<i>Gila bicolor ssp. snyderi</i>	Owens Tui Chub	Fishes
<i>Gila boraxobius</i>	Borax Lake chub	Fishes
<i>Gila cypha</i>	Humpback chub	Fishes
<i>Gila ditaenia</i>	Sonora chub	Fishes
<i>Gila elegans</i>	Bonytail	Fishes

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Wherever found

<i>Gila intermedia</i>	Gila chub	Fishes
<i>Gila nigrescens</i>	Chihuahua chub	Fishes
<i>Gila purpurea</i>	Yaqui chub	Fishes
<i>Gila robusta jordani</i>	Pahrnagat roundtail chub	Fishes
<i>Gila seminuda robusta</i>	Virgin River Chub	Fishes
<i>Huso dauricus</i>	Kaluga sturgeon	Fishes
<i>Huso huso</i>	Beluga sturgeon	Fishes
<i>Hybognathus amarus</i>	Rio Grande Silvery Minnow	Fishes
<i>Hymenophysa curta</i>	Ayumodoki loach	Fishes
<i>Hypomesus transpacificus</i>	Delta smelt	Fishes
<i>Ictalurus pricei</i>	Yaqui catfish	Fishes
<i>Latimeria chalumnae</i>	African coelacanth	Fishes
<i>Lepidomeda albivallis</i>	White River spinedace	Fishes
<i>Lepidomeda mollispinis pratensis</i>	Big Spring spinedace	Fishes
<i>Lepidomeda vittata</i>	Little Colorado spinedace	Fishes
<i>Meda fulgida</i>	Spikedace	Fishes
<i>Menidia extensa</i>	Waccamaw silverside	Fishes
<i>Moapa coriacea</i>	Moapa dace	Fishes
<i>Notropis albizonatus</i>	Palezone shiner	Fishes
<i>Notropis buccula</i>	Smalleye Shiner	Fishes
<i>Notropis cahabae</i>	Cahaba shiner	Fishes
<i>Notropis girardi</i>	Arkansas River shiner	Fishes
<i>Notropis mekistocholas</i>	Cape Fear shiner	Fishes
<i>Notropis oxyrhynchus</i>	Sharpnose Shiner	Fishes
<i>Notropis simus pecosensis</i>	Pecos bluntnose shiner	Fishes
<i>Notropis topeka</i>	Topeka shiner	Fishes
<i>Noturus baileyi</i>	Smoky madtom	Fishes
<i>Noturus baileyi</i>	Smoky madtom	Fishes
<i>Noturus crypticus</i>	Chucky Madtom	Fishes
<i>Noturus flavipinnis</i>	Yellowfin madtom	Fishes
<i>Noturus flavipinnis</i>	Yellowfin madtom	Fishes
<i>Noturus flavipinnis</i>	Yellowfin madtom	Fishes
<i>Noturus flavipinnis</i>	Yellowfin madtom	Fishes
<i>Noturus placidus</i>	Neosho madtom	Fishes
<i>Noturus stanauli</i>	Pygmy madtom	Fishes
<i>Noturus stanauli</i>	Pygmy madtom	Fishes
<i>Noturus trautmani</i>	Scioto madtom	Fishes
<i>Oncorhynchus kisutch</i>	Coho salmon	Fishes
<i>Oncorhynchus kisutch</i>	Coho salmon	Fishes
<i>Oncorhynchus kisutch</i>	Coho salmon	Fishes
<i>Oncorhynchus kisutch</i>	Coho salmon	Fishes
<i>Oncorhynchus mykiss</i>	Steelhead	Fishes
<i>Oncorhynchus mykiss</i>	Steelhead	Fishes
<i>Oncorhynchus mykiss</i>	Steelhead	Fishes
<i>Oncorhynchus mykiss</i>	Steelhead	Fishes

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Tanzanian Distinct Population Segment

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The Tellico River, between the backwaters of the Tellico Reservoir  
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U.S.A.

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Central California Coast ESU - See 50 CFR 224.101  
Lower Columbia River ESU - See 50 CFR 223.102  
Oregon Coast ESU - See 50 CFR 223.102  
Southern Oregon - Northern California Coast ESU - See 50 CFR 223.102  
Southern California DPS - See 50 CFR 224.101  
Middle Columbia River DPS - XN - See 50 CFR 223.102  
California Central Valley DPS - See 50 CFR 223.102  
Central California Coast DPS - See 50 CFR 223.102

<i>Oncorhynchus mykiss</i>	Steelhead	Fishes
<i>Oncorhynchus mykiss</i>	Steelhead	Fishes
<i>Oncorhynchus mykiss</i>	Steelhead	Fishes
<i>Oncorhynchus mykiss</i>	Steelhead	Fishes
<i>Oncorhynchus mykiss</i>	Steelhead	Fishes
<i>Oncorhynchus mykiss</i>	Steelhead	Fishes
<i>Oncorhynchus mykiss</i>	Steelhead	Fishes
<i>Oncorhynchus mykiss</i>	Steelhead	Fishes
<i>Oncorhynchus nerka</i>	Sockeye salmon	Fishes
<i>Oncorhynchus nerka</i>	Sockeye salmon	Fishes
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	Fishes
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	Fishes
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	Fishes
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	Fishes
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	Fishes
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	Fishes
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	Fishes
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	Fishes
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	Fishes
<i>Oncorhynchus aguabonita whitei</i>	Little Kern golden trout	Fishes
<i>Oncorhynchus apache</i>	Apache trout	Fishes
<i>Oncorhynchus clarkii henshawi</i>	Lahontan cutthroat trout	Fishes
<i>Oncorhynchus clarkii seleniris</i>	Paiute cutthroat trout	Fishes
<i>Oncorhynchus clarkii stomias</i>	Greenback Cutthroat trout	Fishes
<i>Oncorhynchus gilae</i>	Gila trout	Fishes
<i>Oncorhynchus keta</i>	Chum salmon	Fishes
<i>Oncorhynchus keta</i>	Chum salmon	Fishes
<i>Pangasianodon gigas</i>	Thailand giant catfish	Fishes
<i>Pangasius sanitwongsei</i>	Catfish	Fishes
<i>Percina antesella</i>	Amber darter	Fishes
<i>Percina aurolineata</i>	Goldline darter	Fishes
<i>Percina aurora</i>	Pearl darter	Fishes
<i>Percina jenkinsi</i>	Conasauga logperch	Fishes
<i>Percina pantherina</i>	Leopard darter	Fishes
<i>Percina rex</i>	Roanoke logperch	Fishes
<i>Percina tanasi</i>	Snail darter	Fishes
<i>Phoxinus cumberlandensis</i>	Blackside dace	Fishes
<i>Plagopterus argentissimus</i>	Woundfin	Fishes
<i>Plagopterus argentissimus</i>	Woundfin	Fishes
<i>Poeciliopsis occidentalis</i>	Gila topminnow	Fishes
<i>Prietella phreatophila</i>	Mexican blindcat catfish	Fishes
<i>Pristis clavata</i>	Dwarf sawfish	Fishes
<i>Pristis pectinata</i>	Smalltooth sawfish	Fishes
<i>Pristis pectinata</i>	Smalltooth sawfish	Fishes
<i>Pristis pristis</i>	Large tooth Sawfish	Fishes



Lower Columbia River DPS - See 50 CFR 223.102

Middle Columbia River DPS - See 50 CFR 223.102

Northern California DPS - See 50 CFR 223.102

Puget Sound DPS - See 50 CFR 223.102

Snake River Basin DPS - See 50 CFR 223.102

South-Central California Coast DPS - See 50 CFR 223.102

Upper Columbia River DPS - See 50 CFR 223.102

Upper Willamette River DPS - See 50 CFR 223.102

Snake River ESU - See 50 CFR 224.101

Ozette Lake ESU - See 50 CFR 223.102

Sacramento River winter-run ESU - See 50 CFR 224.101

Upper Columbia River spring-run ESU See 50 CFR 224.101

California Coastal ESU - See 50 CFR 223.102

Central Valley spring-run ESU See 50 CFR 223.102

Lower Columbia River ESU See 50 CFR 223.102

Puget Sound ESU See 50 CFR 223.102

Snake River fall-run ESU See 50 CFR 223.102

Snake River spring/summer-run ESU See 50 CFR 223.102

Upper Willamette River ESU See 50 CFR 223.102

Wherever found

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Wherever found

Columbia River ESU See 50 CFR 223.102

Hood Canal summer-run ESU - See 50 CFR 223.102

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Wherever found, except where listed as an experimental population

Gila R. drainage, AZ, NM

Wherever found

Wherever found

Wherever found

Non-US DPS - Smalltooth sawfish originating from non-US waters

US DPS - Smalltooth sawfish originating from U.S. waters.

Wherever found

Pristis zijsron	Green sawfish	Fishes
Probarbus jullieni	Ikan temoleh minnow	Fishes
Ptychocheilus lucius	Colorado pikeminnow	Fishes
Ptychocheilus lucius	Colorado pikeminnow	Fishes
Rhinichthys osculus lethoporus	Independence Valley speckled dace	Fishes
Rhinichthys osculus nevadensis	Ash Meadows speckled dace	Fishes
Rhinichthys osculus oligoporus	Clover Valley speckled dace	Fishes
Rhinichthys osculus thermalis	Kendall Warm Springs dace	Fishes
Salmo platycephalus	Ala balik trout	Fishes
Salmo salar	Atlantic salmon	Fishes
Salvelinus confluentus	Bull Trout	Fishes
Salvelinus confluentus	Bull Trout	Fishes
Scaphirhynchus albus	Pallid sturgeon	Fishes
Scaphirhynchus platyrhynchus	Shovelnose Sturgeon	Fishes
Scaphirhynchus suttkusi	Alabama sturgeon	Fishes
Scleropages formosus	Asian bonytongue	Fishes
Sebastes paucispinis	Bocaccio	Fishes
Sebastes pinniger	canary rockfish	Fishes
Sebastes ruberrimus	yelloweye rockfish	Fishes
Speoplatyrhinus poulsoni	Alabama cavefish	Fishes
Sphyrna lewini	Scalloped Hammerhead Shark	Fishes
Sphyrna lewini	Scalloped Hammerhead Shark	Fishes
Sphyrna lewini	Scalloped Hammerhead Shark	Fishes
Sphyrna lewini	Scalloped Hammerhead Shark	Fishes
Squatina squatina	Angel shark	Fishes
Tanakia tanago	Miyako tango (Toyko bitterling)	Fishes
Thaleichthys pacificus	Eulachon	Fishes
Tiaroga cobitis	Loach minnow	Fishes
Xyrauchen texanus	Razorback sucker	Fishes



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Experimental Population, Non-Essential
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Experimental Population, Non-Essential
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Similarity of Appearance to a Threatened Taxon
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Salt and Verde R. drainages, AZ
Wherever found
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Gulf of Maine DPS - See 50 CFR 224.101
Clackamas River subbasin and the mainstem Willamette River, from Willamette Falls to its points of confluence with the U.S.A., conterminous,
Wherever found
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Puget Sound-Georgia Basin DPS See 50 CFR 224.101
Puget Sound - Georgia Basin DPS See 50 CFR 223.102
Puget Sound - Georgia Basin DPS See 50 CFR 223.102
Wherever found
Eastern Atlantic DPS
Eastern Pacific DPS
Central and Southwest Atlantic DPS
Indo-West Pacific DPS
Entire
Wherever found
Southern DPS - See 50 CFR 223.102
Wherever found
Wherever found

<b>Traits</b>	<b>r-selected spp</b>	<b>K-selected spp</b>
Life Span	Short	Long
Time to reproductive maturity	Short	Long
Number of reproductive events	Many	Few
Number of offspring	Many	Few
Size of offspring	Small	Large
Parental care	Absent	Present
Population growth rate	Fast	Slow
Population regulation independent	Density	Density dependent
Population dynamics	Highly Variable	Stable, near carrying capacity